

2002 Crescent Lake Hydroacoustic Escapement Survey

Field Report

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Introduction

In 1996 Douglas Island Pink and Chum, Inc. (DIPAC) a non-profit enhancement organization based in Juneau, AK., signed a 20 year contract with the Alaska Department of Fish and Game (ADF&G) for the operations of the Snettisham Hatchery located in Port Snettisham, 56km southeast of Juneau. The releases of sockeye salmon (*Onchorynchus nerka*) smolts from the Snettisham Hatchery are starting to produce large returns of adult sockeye to the Taku/Stephens Passage (District 111) fishery. These returns are requiring ADF&G the need for more information to manage this wild/enhanced mixed fishery. The management plan for the Taku/Stephens Passage area, specifically Snettisham Inlet, focuses on the conservation of the wild stocks of sockeye salmon. In 2000 the Board of Fisheries (BOF) developed a Port Snettisham Hatchery Management Plan that defines the management goals for these enhanced sockeye. The plan reads:

5AAC 33.378 DISTRICT 111: PORT SNETTISHAM HATCHERY MANAGEMENT PLAN.

- (a) The intent of this management plan is to provide basic guidelines for managing enhanced sockeye salmon production from Port Snettisham.
- (b) The Department shall manage returns from the Snettisham enhancement program to ensure in order of priority:
 - (1) Sustainable production of wild sockeye salmon from Crescent and Speel Lakes.
 - (2) Management of enhanced Snettisham sockeye returns may not prevent achieving escapement goals or Pacific Salmon Treaty harvest sharing agreements for Taku River salmon stocks.
 - (3) Assessment programs shall be conducted frequently during harvest and annually to estimate Snettisham wild sockeye stock escapements and contributions of enhanced sockeye to the District 111 commercial fisheries.
 - (4) Common property harvests in the SHA shall be conducted by limiting the time and area to protect the wild sockeye salmon runs.

This management plan put an additional requirement upon DIPAC to also enumerate the escapement of adult sockeye salmon into Crescent Lake.

During the sockeye salmon spawning runs of 1977, 1978 and 1983-1992, ADF&G maintained a large weir on the Crescent Lake outlet to conduct annual escapement surveys. However, the data collected was considered suspect since the weir was not consistently fish tight. This was due to a number of reasons such as the rivers susceptibility to flooding and uneven bottom. Nevertheless, in 2001, DIPAC with the assistance of ADF&G, attempted to construct a weir in the Crescent Lake outlet, in order to fulfill its requirements to the BOF. High water prohibited the crew from successfully installing the weir allowing the sockeye to

pass uncounted. Therefore, before the end of the return, DIPAC and ADF&G explored other methods to enumerate the escapement of sockeye salmon into the lake. Two trips to the lake followed with the second trip involving Eric Prestegard (DIPAC), Hal Geiger (ADF&G) and Sam Johnston of Hydroacoustic Technology, Inc. (HTI) testing the feasibility of using hydroacoustics for enumerating the escapement of sockeye salmon and providing good in-season information to ADF&G for management of the fishery.

Hydroacoustic technology has been applied to estimate adult salmonid escapement in over 60 rivers in North America and Europe since the 1960's (Ransom et. al. 1999). In Alaska, some of the published studies that used riverine hydroacoustics to evaluate migrating fish have been conducted on the:

Chandalar River: chum salmon (*O. keta*) (Daum and Osborne 1995; Johnston and Daum 1995).

Kenai River: king salmon (*O. tshawytscha*), coho salmon (*O. kisutch*) and sockeye salmon (Burwen et. al. 1995; Johnston 1985, 1986; Vaughn and Skvorc 1993).

Susitna River: king, chum and sockeye salmon (Ransom et al. 1986).

Yukon River: king and chum salmon (Johnston et al. 1993).

Hydroacoustics allow for a noninvasive and nondestructive means of estimating the number of fish passage (Enzenhofer et al. 1998). In addition, hydroacoustic data can be analyzed as it is collected, allowing for in-season estimates of fish abundance. The greatest asset of hydroacoustics is its speed and accuracy as a fish quantification technique (Ransom and Steig 1993). Hydroacoustics is regularly used to collect continuous data 60min/hour, 24hrs/day for months at a time. The technical advancement of hydroacoustics has led to the development of split-beam systems, which can determine the relative size of a fish, its direction of movement and its speed of travel when it passes through the sonar beam. However, to date, hydroacoustic equipment lacks the ability to identify fish species.

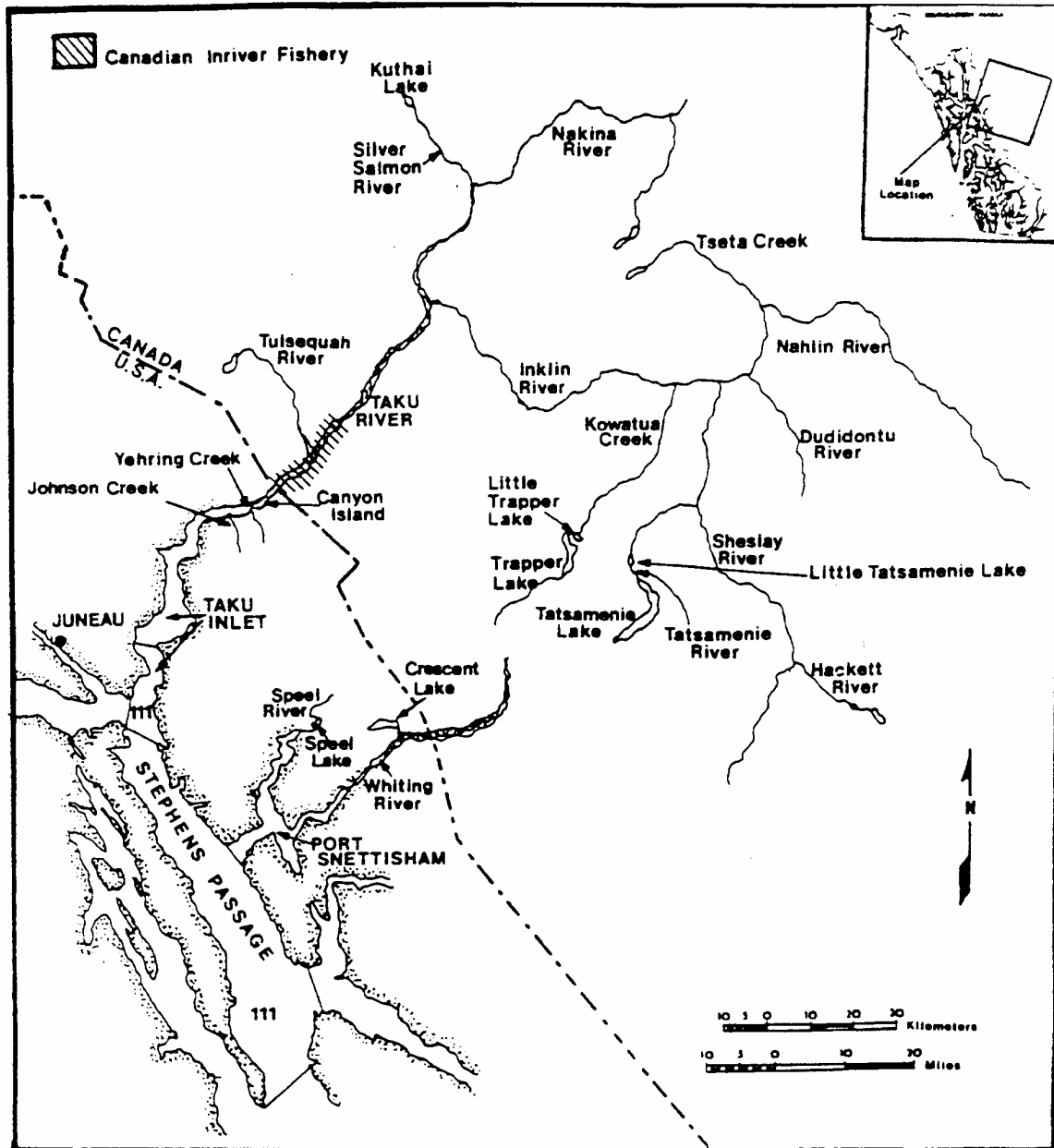
In the 2002 Crescent Lake survey, a fixed-location, split-beam hydroacoustics system was utilized to estimate the escapement of sockeye salmon. This is the first attempt to assess the spawning run of sockeye salmon in the Crescent Lake outlet using hydroacoustics. The primary objective of this survey was to provide ADF&G fisheries managers with an in-season relative abundance tool to help aid in the decision making process of managing wild sockeye salmon.

Survey Site

Crescent Lake is located approximately 80 km southeast of Juneau, Alaska in the Tongass National Forest (Fig. 1). The principle water sources of Crescent Lake include rainfall, snowmelt and runoff from glaciers. Turbidity varies throughout the summer depending on the amount of rainfall. All five

species of Pacific salmon (*Oncorhynchus* spp.) can be found in the river depending on the time of the year,

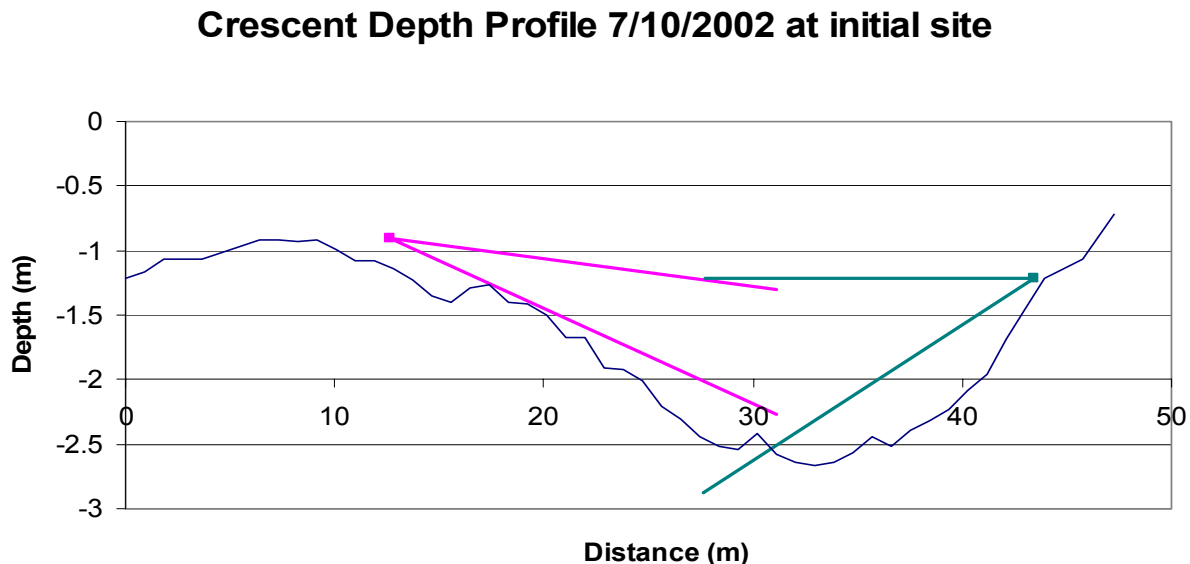
Figure 1.



As mentioned above, on August 15, 2001, Sam Johnston (HTI) began the initial evaluation of the survey site. A location near an existing tent-platform, near the historic weir site, just downstream of the mouth of Crescent Lake, was deemed suitable for sonar installment. On July 10, 2002, a bottom profile of the transect line between the proposed placement sites of the 2 transducers was produced (Fig. 2). When looking downstream, the transect line ran from the edge of the left bank (0m) across the main section of the river to the edge of a narrow island (46.1m). The left bank of the river is composed of sand and small

gravel. The right bank (technically the left bank of the island) of the river has a series of large boulders that form a steep shelf and a wall along the river edge. The river bottom was relatively free of large boulders, allowing us to aim the acoustic beam close to the bottom of the river bed. River depth and width changed throughout the season due to flow fluctuation. Overall the site of the transducer deployment had a relatively laminar flow. A portable tent was set-up to house the hydroacoustic equipment. The tent was placed near the river bank so that the transducer cables could reach the equipment.

Figure 2.



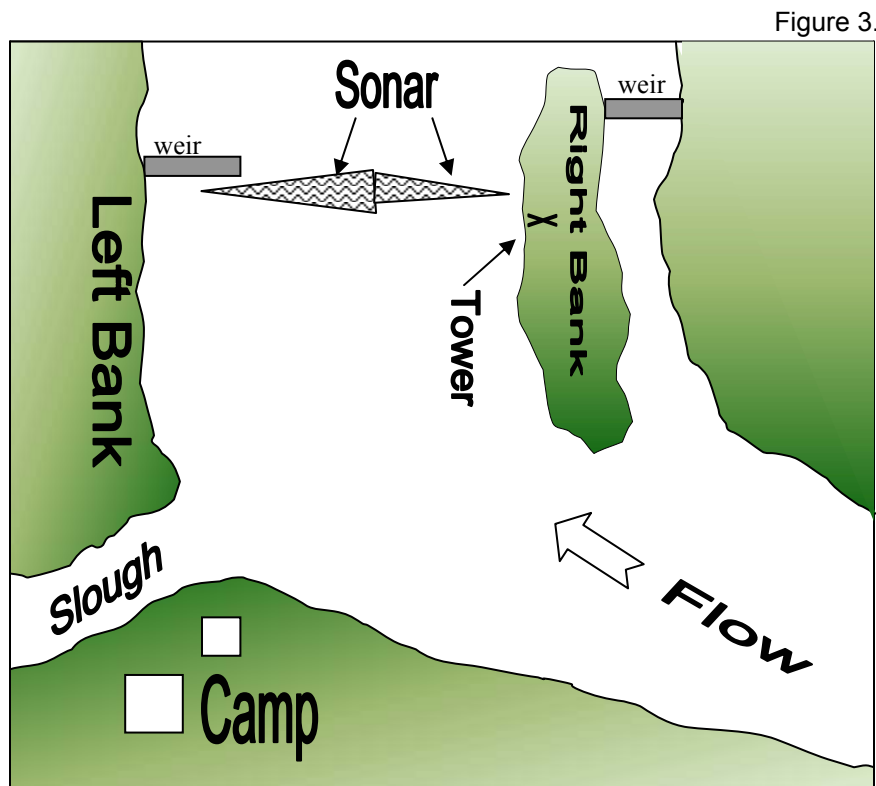
Camp Site

As there were no roads leading to the remote campsite, all of the equipment, personnel and supplies were flown in. A 16x20ft. tent-platform, with a canvas and visqueen cover was utilized as sleeping quarters and to house camping equipment and personal gear. We were outfitted with a propane cooking stove and a diesel heater. For daily communication with Snettisham Hatchery we relied on a single-side band radio and for contact with a nearby weir camp at Speel Lake we used a VHF radio. When the single-side band radio was not functioning correctly, and in case of an emergency, we used a satellite telephone. For health and safety purposes we were provided with a well-stocked first aid kit and 2 firearms. For transportation on the river we used a skiff with an outboard motor and a canoe.

Materials & Methods

On July 8th, 2002 Patrick Neilson of HTI, orchestrated the deployment of the hydroacoustic equipment. Hal Geiger and Mark Olsen of ADF&G along with Kevin Steck, Bonnie Trejo, and Anthony Heacock of DIPAC assisted in the set-

up. Two split-beam transducers were placed on opposite sides of the river, in order to maximize the beam coverage of the water column. The placement of the transducers was determined by Patrick using the information collected on the bottom profile of the river and his knowledge of hydroacoustics. Both transducers were operated at a frequency of 200 KHz. The transducer used produce an elliptical beam that widens as the beam is extended. A $3^{\circ} \times 10^{\circ}$ transducer was used on the left side, located 12.7m from the bank of the river at a depth of 1.14m. The beam length was set at 17.2m. A wing weir was placed downstream of the left bank transducer to force the fish to swim in front of the transducer beam. A $6^{\circ} \times 10^{\circ}$ transducer was used on the right side, with a beam length of 15.8m. This transducer was placed 1.32m from the right stream bank, at a depth of 1.22m. Due to the fact that an island was in the middle of the river, a short weir was installed from the far right bank of the river to the island in order to channel fish through the main flow of the river and the transducer beams. For survey site layout see figure 3.



Both transducers were connected to an HTI Model 241 Digital Echo Sounder. The echo sounder controls the transmitting, receiving, amplification, and timing of the signals. The received signal was converted from sonar to digital, which allowed for computer analysis. Each transducer was also connected to a rotator, which allowed the operators to aim the beam to a desired position. An oscilloscope was connected to the echo sounder to monitor the system operation by providing a visual indication of the amplitude of the returning

signals. An 850 watt generator was used to power the equipment and charge two 12volt batteries during the day. The two batteries were then used to power the system at night.

A laptop computer and software provided by HTI, allowed for the collection and processing of data. Hydroacoustical data was collected from July 10th, to August 27th, 2002. Tracking parameters were initially set by Patrick to optimize the capabilities of the equipment for this particular survey. The DEP sounder program created four different output files (*.fsh, *.ech, *.raw, *.sum), which were used for subsequent data processing. The Alpha-Beta Tracker (ABTracker) program was used to provide initial tracking of the echoes from the sounder. Once the initial tracking was completed, the Echoscape program was used to produce an echogram, and to edit out non-fish targets. Most of the editing consisted of removing the tracks created by rocks and boat wakes. After tracking and editing was complete, the data was appended to a daily file. A database program was then used to perform data queries which further edited out unwanted targets. For example, fish targets with target strengths ≥ -32 (the minimum target strength of sockeye salmon) were retained while fish targets that did not meet this criterion were deleted from the days count. After the queries were completed, the database program was used to produce daily reports with hourly totals of upstream and downstream movement. The queried data was then placed into a spreadsheet program which showed the daily and cumulative upstream and downstream counts. Spreadsheets were also used to provide ad hoc graphs, showing daily fish passage and diel movement.

In order to determine if the equipment was measuring targets properly, a calibration test was conducted. It was recommended by HTI technicians that a calibration test be conducted every two weeks to ensure that the system continued to work properly throughout the length of the survey. Calibration was conducted using a tungsten carbide sphere of pre-determined size attached to monofilament line which was lowered into the sonar beam from a skiff. At the same time, another person monitored the DEP sounder program to locate the echoes from the sphere target on an echogram. Once the target was located, information from the echoes was recorded for at least one minute. Calibration was conducted for each transducer. Once the target tracking was complete the file was examined using Echoscape. The observed target strength was compared to the theoretical target strength, which was determined under laboratory conditions by HTI. If the observed target strength was similar to that of the theoretical target strength then it was concluded that the system was working properly. If the observed target strength was not within an acceptable range, then it could be determined that the system was not measuring target strength properly and HTI should be contacted immediately (this never occurred).

On July 15th, we discovered that the left bank transducer was no longer producing a signal. We tried re-aiming the beam to find the bottom of the river, which normally produces a definite signal, but produced no response in this case. We also tried running the boat through the beam, but this didn't provide any sign of response either. On July 16th, we switched the two main output lines on the back of the sounder to determine if we had a transducer malfunction or a

sounder problem. After making the switch the left bank transducer became operational and the right bank transducer was un-operational. We therefore determined that the sounder had a malfunction with the output of the signal for the left bank transducer. Up to this point, a majority of our fish were being counted with the left bank transducer. Therefore, in order to maintain a large sample size, we kept the left bank transducer running until repairs could be made. On July 19th, Sam Johnston of HTI arrived along with Rick Focht of DIPAC and Mark Olsen of ADF&G. Sam repaired the sounder and extended the beam length of the left transducer to 18.5m, to provide more beam coverage of the water column.

Sam made changes to our data processing and data collection methods. ABTracker was removed for several reasons related to the programs inability to fast-multiplex (See Addendum to Crescent Lake Procedures Manual). The fish tracking done by the Echoscape program was used in place of the ABTracker program. Sam created new queries in the database program and modified the original queries to work with the new ones. All of the previous data collected prior to Sam's arrival was put through these new queries, in order to rectify the prior data problems caused by ABTracker. In addition, Sam changed the signal being sent from both transducers from chirp to non-chirp.

On July 24th, the right bank transducer signal failed. Fortunately Sam was still on site to determine what went wrong. He found that the sounder component that he had recently repaired had malfunctioned again. With no means to repair the sounder, Sam left us with a spare sounder that he had brought with him and took the original sounder back to Seattle for repairs.

A 2.7m high viewing tower was made and placed on the right bank just upstream of the transducer (Fig. 3). From this tower, observations were made to determine the species of salmon responsible for the upstream and downstream movement. Any fish that was observed passing through the location of the sonar beams in either an upstream or downstream direction was recorded as such. In addition to species identification and direction of travel, time of passage, and distance from the platform was also recorded. There were periods of time especially after heavy rains and flooding when visibility was poor. In addition, there were instances in which only a proportion of a fish was seen and confident identification could not be made. For these cases a category of "Unidentified Salmon" was created.

Due to heavy rains, extensive flooding occurred at the site, requiring the removal of the electronic equipment from the portable tent. The electronic equipment was disconnected from August 9, through August 13, resulting in a total of five days without any data being recorded. Another flood event from August 23rd to August 24th required the disconnection of the equipment for a second time. During this time a total of 16 hours and 47 minutes of data was not collected.

Demobilization of the hydroacoustic equipment and the camp site began on August 27th, 2002. All sonar and electronic equipment were safely packed for removal. The supplies and tools brought to the camp site were also boxed up for

removal. Both weirs were taken apart and stored on site for future use. On August 31st, a float plane was flown in to remove all supplies and crew.

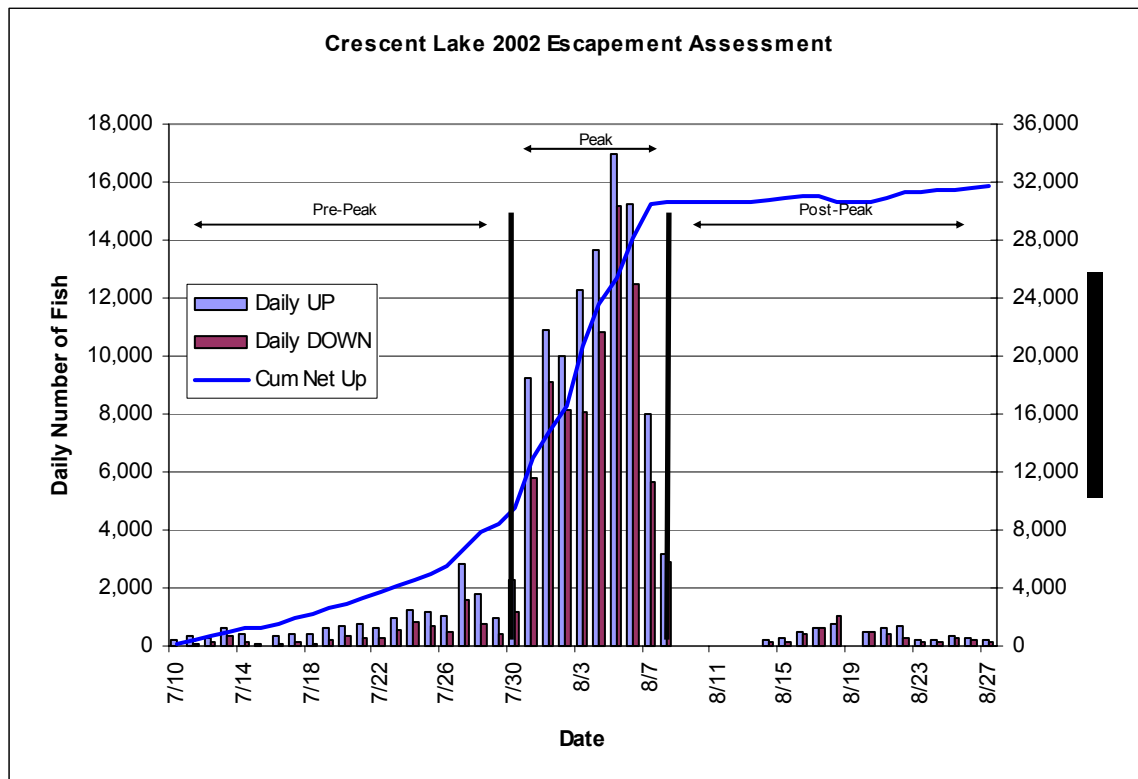
Results

The average water temperature was 10.7°C, with a low of 8.4°C and a high of 14°C. The average water level was 1.59m, with a low of 0.9m and a high of 2.44m.

Hydroacoustic Data

During the length of the survey we recorded a total of 213,959 tracked fish. Of that total, 122,833 fish were recorded moving upstream and 91,126 were recorded moving downstream, resulting in a net upstream movement of 31,707 fish. A plot of the daily upstream and downstream fish passage revealed three distinct segments of the fish migration (Fig. 4). The first segment, which we will refer to as the “Pre-Peak” period, occurred from July 10, through July 30. The second segment of fish movement, referred to as the “Peak” period, occurred from July 31, through August 8. The last segment was from August 14, through August 27, which will be referred to as the “Post-Peak” period.

Figure 4.



During the Pre-Peak period, we recorded a total of 26,678 fish targets. Of this total 18,098 fish (68%) were tracked moving upstream and 8,580 fish (32%) were tracked moving downstream. This resulted in a net upstream movement of 9,518 fish. This number represents 30% of the total net number of fish observed moving upstream. The daily average of fish movement during the Pre-Peak period was 862 upstream and 409 fish moving downstream with a mean daily net upstream count of 453.

During the Peak period, we recorded a total of 177,562 fish targets. Of this total, 99,364 fish (56%) were tracked moving upstream and 78,198 fish (44%) were tracked moving downstream. This resulted in a net upstream movement of 21,166 fish, or 67% of the total number of fish observed. The daily average fish passage during this period of time was 11,040 fish upstream and 8,689 fish downstream with a mean daily net upstream count of 2,351. See Table 1, for a comparison of Pre-Peak and Peak data on fish movement.

Table 1. Comparison of fish movement between the Pre-Peak and Peak periods

<u>Dates</u>	Fish Up	%	Fish Down	%	Total Fish	Net Fish Upstream
Pre-Peak (7/10-7/30)	18,098	68%	8,580	32%	26,678	9,518
Peak (7/31-8/8)	99,364	56%	78,198	44%	177,562	21,166

During the Post-Peak period, we recorded a total of 9,719 fish targets. Of that total 5,371 fish (55%) were tracked moving upstream and 4,348 fish (45%) were tracked moving downstream. This resulted in a net upstream movement of 1,023 fish. This net upstream number represents 3% of the total number of fish observed. The daily average fish movement during this period of time was 429 upstream and 368 fish downstream with a mean daily net upstream count of 61. Due to the relatively small proportion of fish tracked during this period, further analysis was not warranted.

The number of fish tracked and their direction of travel differed between the left and right bank transducers (Tables 2). The left bank transducer tracked the majority of the total fish counted during the Pre-Peak and Peak periods. The left bank transducer also tracked the majority of the fish targets moving upstream. The right bank transducer tracked only 10%-12% of the fish, during the Pre-Peak and the Peak periods. When compared to upstream moving fish on the right and left bank, the right bank transducer had a higher proportion of fish tracked moving downstream.

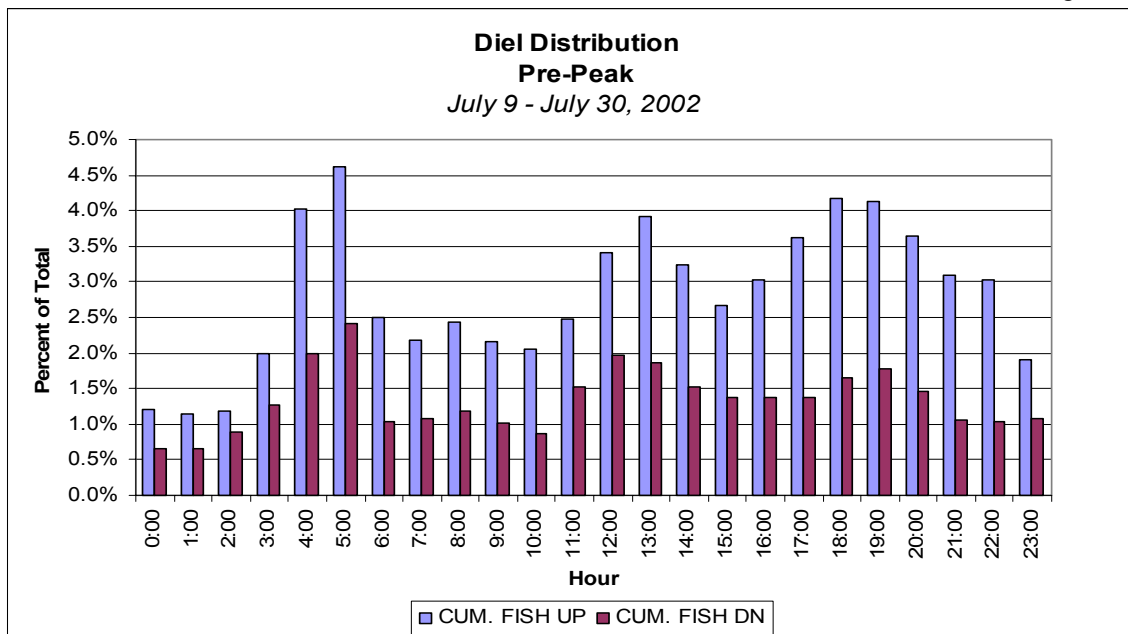
Table 2. Comparison of fish movement between the Pre-Peak and Peak time periods and the left and right bank transducers

<u>Left Bank</u>						
<u>Dates</u>	<u>Fish Up</u>	<u>%</u>	<u>Fish Down</u>	<u>%</u>	<u>Total Fish</u>	<u>%</u>
Pre-Peak (7/10-7/30)	16,747	72%	6,674	28%	23,421	88%
Peak (7/31-8/8)	90,545	57%	68,526	43%	159,071	90%

<u>Right Bank</u>						
	<u>Fish Up</u>	<u>%</u>	<u>Fish Down</u>	<u>%</u>	<u>Total Fish</u>	<u>%</u>
Pre-Peak (7/10-7/30)	1,351	41%	1,906	59%	3,257	12%
Peak (7/31-8/8)	8,819	48%	9,672	52%	18,491	10%

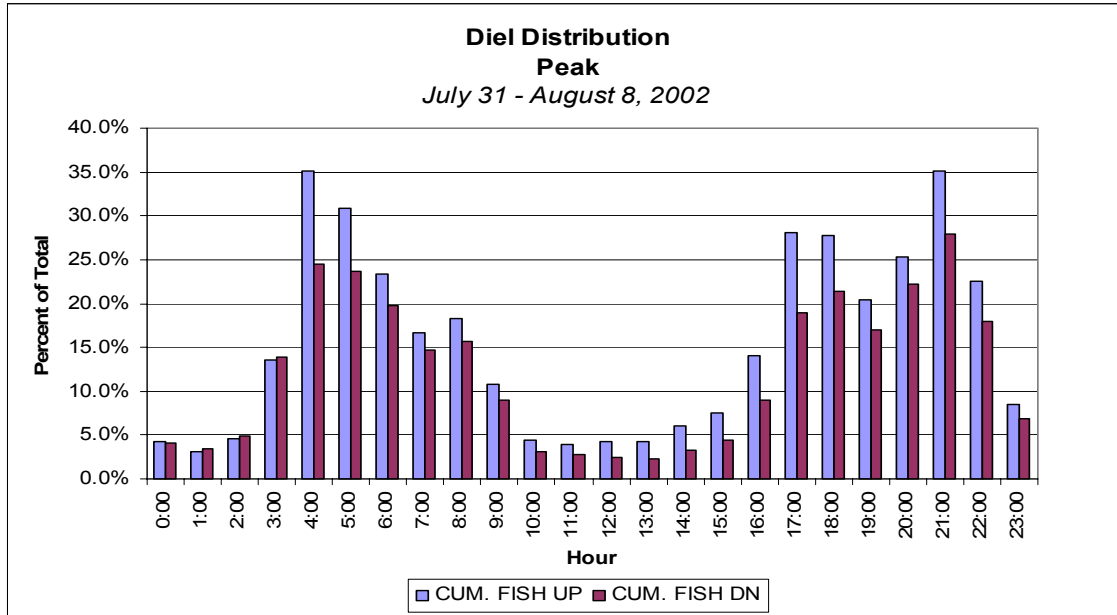
The diel distribution of fish passage during the Pre-Peak and the Peak periods also differed. During the Pre-Peak period, fish passage varied throughout the 24hr period, with upstream and downstream movement slightly weighted toward the PM hours but, no strong trend appeared (Fig. 5).

Figure 5.



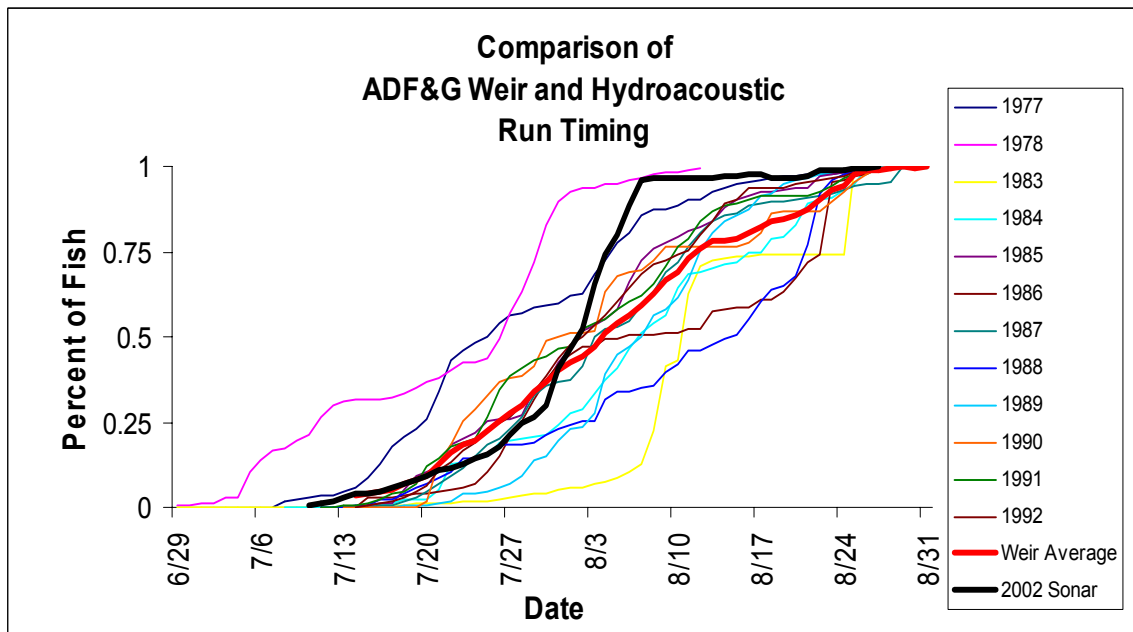
However, during the Peak period, fish passage was greatest around dawn and dusk, with the least amount of activity around noon and midnight (Fig. 6).

Figure 6.



We compared the hydroacoustic escapement data with 11 season's worth of ADF&G weir escapement data to evaluate the run distribution (Fig. 7). Data collected in 2002 by hydroacoustics fits into the overall distribution exhibited throughout the years surveyed. In Figure 7, the sonar data is compared with the averaged ADF&G weir counts. The line representing the ADF&G weir data collected over 11 seasons, exhibits a smoothing effect as the result of a larger sample size.

Figure 7.



Tower Observation Data

Observations from the viewing tower were made between July 20, and August 21, 2002. Table 3, depicts the cumulative upstream and downstream numbers of all species observed from the tower. The majority of fish identified were sockeye salmon, with a net upstream count of 260. King salmon was the second most frequently observed species. They were equally observed moving both upstream and downstream, resulting in a net upstream count of 0. Chum salmon were the third, and pink salmon the fourth most observed species. The observation data collected on these two species had similar results as that of the chum salmon. Tower observations showed that while non-sockeye species represented only 29% of the total fish observed, they accounted for 58% of the total downstream movement.

Table 3. Tower observation results of upstream and downstream movement of salmon species.

Direction of movement	Species			
	Sockeye	King	Chum	Pink
Up	316	31	27	20
Down	56	31	26	19
Net Upstream	260	0	1	1

Discussion

The results of this survey indicate that hydroacoustics provides a good estimate of the strength and magnitude of the sockeye salmon run, as well as, give indices of run timing and diel distributions. According to Mulligan and Kieser (1986) whether hydroacoustic estimates of fish passage are conservative or liberal is probably of no consequence because a steady relative abundance provides many of the same advantages as an absolute estimate. In this discussion, we will attempt to describe the factors that affect the reliability of hydroacoustic data, as well as, discuss how the results of this survey can be utilized by management agencies. Lastly, we will make recommendations for future surveys.

Estimate of Sockeye Salmon Passage

A linear correlation exists between the length of a fish and its target strength (dB) (Using Hydroacoustics for Fisheries Assessment 1999). In addition, pulse width has also been shown to have a correlation with fish size (Burwen and Fleischman 1998; Nealson and Gregory 2000). Both Pat Nealson

and Sam Johnston of HTI were able to set the parameters of the automated tracking and database programs, to best retain targets that exhibit characteristics associated with sockeye salmon. However, the parameters could not eliminate the system from tracking king, chum and pink salmon.

The inquiry of species identification is what led to the concept and implementation of the observation tower. Observation tower counts have led us to concur that the majority of fish counted using hydroacoustics, were sockeye salmon. Results of the observation tower counts indicate that more sockeye salmon passed the hydroacoustic survey site heading upstream than any other species observed. However, because we cannot place a definitive percentage as to how many of the total tracked fish were indeed sockeye salmon, the data collected is meant to act as a relative gauge of sockeye salmon abundance and not as an exact count.

Fish Behavior

Milling behavior was first noticed during the Pre-Peak period, while editing the data in Echoscape. It was later confirmed through observations from the tower. High numbers of downstream moving fish (as was the case in this survey) is often an indication of milling behavior (Using Hydroacoustics for Fisheries Assessment 1999). Milling behavior can cause the hydroacoustic system to count the same fish over and over as it passes through the sonar beam. Therefore, it is important to make calculation adjustments in order to reduce the effects of milling. Crescent River is a closed system, hence, we assumed that the salmon that were tracked moving downstream had to first pass the acoustic site traveling upstream. We also assume that fish moving downstream are equally likely to be detected by the sonar equipment as the fish moving upstream. Thus, we calculated the cumulative net upstream number by subtracting the overall downstream count from the overall upstream count. This adjustment should correct the influence of milling fish as long as the automated tracking system is tracking fish correctly.

In addition to the milling behavior, fish were also observed holding in the sonar beam. Holding can also lead to over counting because, one fish can appear as a very long trace on an echogram and these long traces may be counted as more than one fish. The split-beam system can distinguish a typical migrating fish trace from one that remains stationary in the beam (which instead of crossing the beam axis, enters the beam from one side then exits the beam from the same side that it entered) (Using Hydroacoustics for Fisheries Assessment 1999). To minimize the effect of holding fish, HTI technicians set a minimum range parameter (0.2m/ping) in the automating tracking system to eliminate fish traces that did not travel a particular distance through the sonar beam. In addition to program parameters, manual editing can also minimize the effects of holding. However, the editing of holding fish was not consistent throughout the survey. It took time for us to recognize the fish traces of this problematic behavior on the echogram and how to edit it accordingly.

Run Timing

The similarities between the hydroacoustic and the ADF&G weir escapement data indicate that the sonar data provides a good source of information on sockeye salmon run timing. The timing of spawning runs tends to be relatively constant. With hydroacoustic data, technicians in the field can report the timing of the run coupled with its relative magnitude, on a daily basis. This information can be used to better inform managers of in-season trends allowing them to make more timely regulation decisions.

Diel Distribution

The hourly trends of fish movement can be used for in-season determination of the most optimal times of the day to conduct tower observations. By conducting tower observations during peak periods of fish migration, the observer increases his/her probability of viewing higher numbers of salmon and collecting more useful data.

Left Bank vs. Right Bank

Information collected exhibit differences between the two banks with regard to the number of fish counted and their direction of travel. The left bank transducer counted a large proportion of the cumulative fish count. One reason for this could be that the transducer beam on the left side was extended farther than the right side, surveying more of the river than the right side was. Another difference is that a higher proportion of the total fish counted by the left bank transducer were moving upstream, while a higher proportion of the total fish counted by the right bank transducer were moving downstream. This may be explained by differences in the rate of water flow. Salmon may be taking advantage of the slower current on the left side of the thalweg when swimming upstream and may utilize the faster current on the right side when traveling downstream.

Recommendations

Further Investigations

The Crescent River hydroacoustic system is still in its early stages of development. The continued working relationship between DIPAC and ADF&G is needed to both further evaluate the hydroacoustic system and to allow for the potential of additional studies. However, in order for DIPAC to facilitate additional evaluation of this project further funding sources are needed.

Fish orientation near the sonar beam boundaries, low signal to noise ratios and bottom contours (such as rocks) can affect the detectability of passing fish (Daum and Osborn 1998, Johnston and Hopelain 1990, Mesiar et al. 1990). Evaluation of potential counting biases related to fish behavior and beam positioning can be evaluated with split-beam technology (Mulligan and Kieser 1996). In addition, examination of the assumption of equal detectability of upstream and downstream traveling fish, and assessment of the vertical and horizontal distribution of fish in the beam can further contribute to the scientific defendability of the sampling method. We suggest that further post-season analysis of the edited data files be conducted by HTI technician or by other person(s) with hydroacoustic experience and that these more experienced technicians provide suggestions for some validation tests that can be conducted next season.

If possible, ABTracker should be used as the primary autotracking program, provided that the problems associated with this program are fixed. The continuation and improvement of the observation tower surveys can lead to a better understanding of the species composition as well as provide visual confirmations of fish behavior in the sampling area.

Transducer Placement

Due to the amount of fish observed holding and milling, moving the transducers to a different location should be considered. We recommend that the transducers be placed slightly upstream near the point where the river makes a 90° turn towards the lake (see HTI initial report on hydroacoustic feasibility). This location has a faster rate of flow, possibly decreasing the amount of fish holding in the beams. Although, the problem of fish milling may be a constant problem that is inherent to the site.

Tower Placement

Since a large majority of the fish were counted by the left bank transducer, we recommend that the viewing tower be placed in the river as close to the left bank transducer as possible. This would position the tower on the side of the river where the most fish activity has been recorded. A tower that is higher than the one used this season, as well as, one that has more than one level area for viewing would allow the surveyor more versatility to maximize their viewing capabilities in relation to the glare on the water surface and other viewing hindrances. A rope tied across the length of the river from one transducer to the other can aid a surveyor in deciding the timing that the fish pass the sonar beams. We found that weather conditions such as heavy rains and hard winds hampered visibility to the point where some daily surveys were canceled. In addition, the clarity of the Crescent Lake outlet is limited by the influx of glacial silt which impedes visibility especially after heavy rains. A brimmed hat and polarized sun glasses are a must.

Power Source

Although the power source has been given little attention thus far it should be considered one of the most important aspects to this survey. The 850 watt generator used powered the electronic equipment by day and also charged the batteries which were used to power the equipment by night. The generator was also used to charge batteries that were used to power the radios and heater.

Unfortunately we were unable to come up with a method to provide constant power to the equipment when we switched the power source from the generator to the batteries and visa-versa. This temporary lack of power had implications regarding the operation of the digital echo sounder. Several attempts were made to rectify this issue but they were all inadequate. We recommend that this problem be solved prior to installation next season. The key to fixing this problem may be found in better utilization of the battery back-up (UPS). A better battery can be used to provide a longer duration of charge.

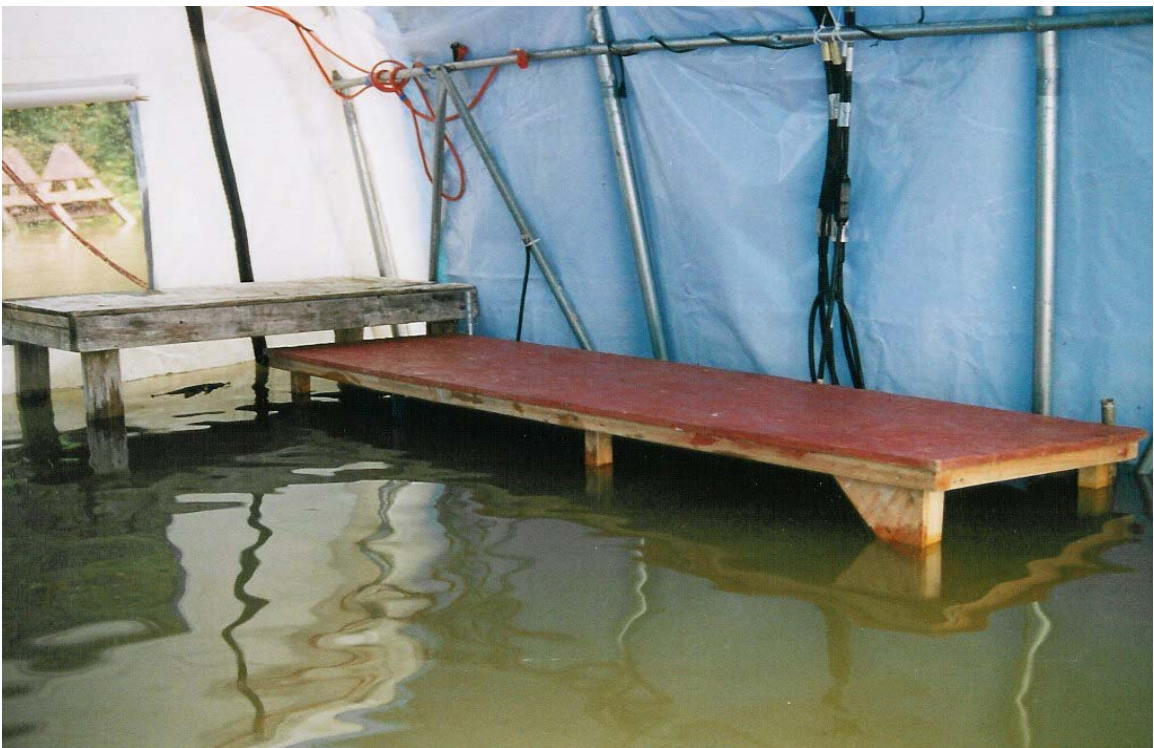
Camp Improvements

An elevated tent platform should be constructed to house all the electrical equipment. We had to disconnect the equipment on two different occasions due to high water levels. An elevated platform would alleviate this problem. The generator should also be placed on an elevated position so that it is not subject to flooding. The generator should be located away from the hydroacoustic equipment and camp platforms so that the carbon monoxide emitted is not a health factor. The noise factor is another reason to have the generator placed away from the equipment platform and the tent platform.

The cover for the equipment tent is white which makes it very difficult to see the computer screen because of glare. Blue tarps placed over the tent helped but did not alleviate the problem, a black tarp or visqueen cover may work better. The equipment tent should also have two more windows installed, to allow for more ventilation of the electronic equipment. The amount of condensation in the tent was so high that the DAT Recorder would not operate at times. The tent should be oriented so that a person sitting at the computer can look out the windows and see the area that the transducers are located. This would be especially helpful when conducting calibration tests. A reliable hand held VHF radio is very important to have, particularly when communication between technicians is required when calibrating the hydroacoustic equipment. A portable toilet or honey bucket should be available during times of high water.



Pat Neelson (HTI) sitting adjacent to hydroacoustic equipment.



Equipment removed due to flooding, water did eventually cover the tables.



Crescent River looking downstream from the camp, "X" marks the placement of the two transducers.



Tent-Platform, (from left to right) Steve Reid, Kevin Steck, Tony Heacock and Bonnie Trejo.

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ADDENDUM TO:

PROCEDURES FOR USING THE ABTRACKER
AND ECHOSCAPE TO PRODUCE PASSAGE ESTIMATES AT CRESCENT
LAKE

During review of the 24 hour combined data bases produced by appending the individual hourly databases, as described in the “Appending Files” section of the Procedures, it was determined that all fish in the TrackedFish Table after fish from the first hourly file, were duplicated. This would have the effect of approximately doubling the estimates of both upstream and downstream fish for both ports.

This problem occurred in the appending step of the process, after hourly databases were produced. The hourly databases have correct fish numbers in them prior to appending them into a single daily database by using the “Append” feature of EchoScape.

Initially, it was thought that this problem was the result of minor differences in the way fish are numbered in the *.ECH files produced by the AB Tracker. In AB Tracker, fish are numbered consecutively, regardless of the port from which it came. This is in contrast to the real-time system and EchoScape tracking systems, which have independent numbering for each port. Appending databases created using just the *.RAW and *.FSH files created by SOUNDER.EXE (real-time fish tracking) do not show this phenomenon. However, when hourly databases created using the *.RAW, *.ECH, and *.FSH files from the real-time tracking system were appended, the same problem occurred. It therefore appeared that the problem was directly attributable to EchoScape.

The EchoScape program uses MicroSoft ACCESS database functions internally to do some of the tasks involved in manipulating records within databases. This is done using the actual database engine supplied by MicroSoft with ACCESS, and allows the developers of EchoScape to rely on well tested, commercial software to do common but sometimes complex tasks. EchoScape has been configured to operate using either ACCESS97 or ACCESS 2000. Since this problem has not been observed in previous large scale studies using fast-multiplexing and EchoScape, appending databases was tested on a computer that had ACCESS 97 installed. When *.Raw, *.ECH, and *.FSH files were used to create hourly databases that were subsequently appended into daily databases, there were no duplicate fish.

Removing these duplicate records is easily accomplished however, by using a query function in ACCESS. This query is called FindFirstFish, and was inserted in the query process that summarized fish and removed small fish.

Normally, two queries named Counts-Port1, and Counts-Port2 would read the tracked fish table of each combined 24-hour database. These queries would produce data that the reports named HourlyReport-Port1, and HourlyReport-Port2 ultimately used to produce the final daily summary report. The new query FindFirstFish selects only the first appearance of a duplicate fish record for further processing. New queries named Counts-Port1NoDups and Counts-Port2NoDups were created, as well as companion report functions named HourlyReport-Port1NoDups and HourlyReport-Port2NoDups. These were all stored in a master template database named CrescentMasterQueryNoDups.

If hourly databases are created from *.RAW and *.ECH files generated by the AB Track tracking system and ACCESS 2000, the Procedures need only be changed to use the CrescentMasterQueryNoDups database instead of the original database CrescentMasterQuery for loading the queries into each 24-hr database prior to producing the daily reports. Other smaller scope problems are listed below.

Throughout these investigations, databases and *.ECH files produced by both tracking systems were scrutinized. It was determined that the AB Tracker may not support fast-multiplexing in general. When echoes from each port happen to arrive at the same range, the tracker combines echoes from both ports into a single track (see "Verification of ABTracker *.ECH files and EchoScape Compatibility"). While at low densities this occurrence is rare, at higher densities there may be significant tracking errors due to this problem. Primarily for this reason, it was decided that the EchoScape or real-time tracker would be more appropriate to use with the data from the current sampling scheme for the Crescent site.

Small scope problems in the data flow:

1. When EchoScape and ACCESS 2000 are used to create hourly databases, there is always a starting record with a zero fish number designation that is not a true tracked fish. It lists a start echo value of the first echo in the file and an end echo of the last (absolute ping number) echo in the file. This does not occur when using EchoScape with ACCESS 97.
2. In AB tracker, one occurrence of a single-echo track at the end of a sequence was detected. The fish number of this one-echo fish was the same as the first fish in the next sequence, but it was distant in ping number and would normally not have been associated with the echoes in the first fish of the next sequence, even if tracking across sequences was allowed. Except for this case, AB Tracker appears to not allow tracking the same fish across sequence boundaries, similar to the EchoScape and real-time tracking systems.

When tracking a file with AB Tracker that does not contain data or "Start Sequence" and "End Sequence" lines for the first sequence of the hour, a "Divide by Zero" error is generated by AB Tracker and processing is halted without producing a *.ECH file for that file. A "Divide by Zero" error is an internal program error indicating that AB Tracker is not configured to read files that do not start with Sequence number 1. In the Crescent configuration this condition is possible whenever the system is re-started after 20 minutes after the hour.